



North Slope Borough

PROJECT MANUAL FOR CONSTRUCTION

Contact Creek Bridge
Anaktuvuk Pass, Alaska

TECHNICAL SPECIFICATIONS
95% Submittal

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CONTACT CREEK BRIDGE
ANAKTUVUK PASS, ALASKA

TECHNICAL SPECIFICATIONS
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SECTION 03 46 00 - ARTICULATING CONCRETE BLOCK SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION.

- A. Construct an articulating concrete block mat system (ACB) to the lines, grades, design and dimensions shown on the plans.

1.2 DEFINITIONS.

- A. Articulating Concrete Block (ACB) System. A matrix of concrete block units intended for erosion protection at the base of the bin wall. Units may be hand-placed or pre-assembled into mats connected by cables.
- B. Blocks. Articulating concrete block units will be referred to as blocks.

1.3 SUBMITTALS

- A. Product Data:

For each type of product indicated. Submit material data for the ACB system 20 days prior to placement. Submit testing data for compressive strength, water absorption, and unit weight performed by an agency other than the manufacturer.

- B. Delivery, Storage and Handling.

1. The Contractor shall check products upon delivery to assure that the proper material has been received and is undamaged. All blocks shall be sound and free of defects that would interfere with proper placement or that would impair the strength or longevity of the installation. Blocks with the following defects shall be discarded:
 - a. Blocks with broken appendages.
 - b. Blocks with chips larger than 2 inches in any dimension.
 - c. Blocks with cracks wider than 0.02 inches and longer than 33% of the nominal height.
2. Minor cracks incidental to the usual method of manufacture, or chipping that results from customary methods of handling in shipping, delivery and placement will not be deemed grounds for rejection. Blocks shall be stored in a suitable location away from mud, paint, wet cement, and other contamination or disturbance.

PART 2 - PRODUCTS

2.1 ARTICULATING CONCRETE BLOCK (ACB)

A. The ACB shall meet the following criteria:

TABLE 1. ACB Requirements

<u>Criteria</u>	<u>Required Value</u>	<u>Test Method</u>
Thickness, minimum	8 - 9 inches	N/A
Net Weight/Area, minimum	82-95 psf	Note 1.
Surface Void Area Ratio	10%	Note 2.

1. The weight of the mattress per unit area shall be determined with the nominal joint spacing, in a non-submerged condition.
2. The surface void area ratio shall be determined at the visible (with filled voids) surface of the blocks, with the joints spaced in a neutral position (50%), and shall be expressed as a percentage of the gross mat area. The void area shall include area between the blocks and open cells within the block.

B. Blocks. Articulating concrete block may be wet cast using concrete as specified herein, or dry-cast by a vibratory block forming machine. The blocks shall be manufactured to the following requirements:

1. The minimum compressive strength shall be 4000 psi for an average of 3 units, and 3500 psi for an individual unit. Compressive strength shall be determined by ASTM C 42/C 42M for wet cast blocks, or by ASTM C 140 for dry cast blocks.
2. The maximum water absorption for dry cast units shall be 9 pcf for an average of 3 units, and 12 pcf for an individual unit. Water absorption shall be determined by ASTM C 140.
3. The minimum saturated surface-dry density shall be 140 for average of 3 units.
4. Wet cast concrete shall be air entrained to contain between 4 and 7 percent total air.
5. For freeze-thaw durability tested in accordance with ASTM C 1262, specimens shall comply with either of the following: (1) the weight loss of each of 5 specimens after 100 cycles shall not exceed 1 percent; or (2) the weight loss of each of 5 specimens after 150 cycles shall not exceed 1.5 percent.

C. Cable. Cable is optional and is primarily to facilitate handling & placement of ACB.

1. Cable used for preassembled ACB mattresses shall be sufficiently sized and fastened for the size/weight of the assembled mattresses such that the assembled mattresses can be placed in compliance with OSHA standards. The manufacturer shall be responsible for determining the minimum cable strength compatible with the mattress size for safe handling. Cable strength shall be based on a minimum factor of safety of 5, and include

appropriate reduction factors for mechanically crimped cable, and other fasteners. If applicable, loading conditions shall include the use of a spreader bar for placing the mattresses.

- D. Void and joint filler. For filling the voids in joints, use material that conforming to the gradation below:

<u>Sieve</u>	<u>Percent Passing by Weight</u>
½ in	100%
No. 4	22-55%
No. 200	0-6%

2.2 GEOTEXTILE

- A. Meet AASHTO M 288 Class 1 for Permanent Erosion Control.

PART 3 - EXECUTION

3.1 GRADE PREPARATION

- A. Grading: Grade area of placement to uniform surface, flat or sloping away from the abutment slope. Fill holes and depressions with locally available granular material.
- B. Place Geotextile Erosion Material over graded subgrade.
1. Unroll geotextile directly onto the prepared surface. Stretch geotextile to remove any creases or wrinkles. Do not expose geotextiles to the elements for longer than 5 days after removal of protective covering.
 2. Place and anchor geotextile on the graded surface so it will not be torn or excessively stretched by placement of the ACB.
 3. Join geotextile by overlapping. Overlapped sections must overlap a minimum of 3 feet. Overlap successive geotextile sheets in the direction of flow so that the upstream sheet is placed over the downstream sheet and/or upslope over downslope.
 4. Following placement of the geotextile on the prepared surface, place ACB. Use methods for placing ACB which minimize tearing and/or excessive stretching of the geotextile.

3.2 ACB MAT PLACEMENT.

- A. All placement of blocks shall be in accordance with the manufacturer's recommendations.
- B. Matrix Assembly. Concrete blocks may be assembled on site by hand-placing the individual units either with or without subsequent insertion of cables, or may be pre-assembled into a mattress with lacing cables. Individual units in the system shall be staggered and interlocked for

enhanced stability. Void filler shall be placed to inhibit lateral movement and increase hydraulic stability.

- C. Placement of Pre-Assembled Mattresses. The mattresses shall be placed directly into position, with a maximum space or gap between mattresses of 2 inches in excess of the nominal joint spacing of blocks within the mattress. Mattresses out of alignment shall be lifted and reset. No overlapping of mats will be accepted and no blocks shall project vertically more than 3/4 inch beyond the adjacent blocks.
- D. Hand Placement of Blocks. Hand placed blocks shall be spaced to maximize the ACB ability to articulate. The Contractor shall use adequate alignment control, such as string lines, to keep the block pattern in alignment and the joint spacing consistent and uniform. Initially, no more than two working block rows shall progress simultaneously in the direction of placement. Additional working rows may be added after experience shows that true lines are maintained. The starting position for ACB placement shall be a convenient location for control of the block pattern alignment.
- E. Block Layout Pattern. Align the blocks to be parallel and perpendicular to project features such as the abutment wall. If the pattern becomes skewed to an extent that the joint gap is not acceptable to the Engineer, then cast-in-place concrete joints shall be field located as directed by the Engineer.
- F. Tolerances. The grade shall be maintained in a smooth condition until installation of the blocks. Maximum acceptable block projections (vertical offset from adjacent blocks) shall not exceed 3/4 inch. Typical block projections shall be less than half the maximum projections.
- G. Void and Joint Filler. Fill and compact voids in the ACB system to be flush with the top of the blocks.

END OF SECTION 03 46 00

SECTION 05 12 00 - STRUCTURAL STEEL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION

- A. Construct steel structures according to the Plans. Furnish, fabricate, erect, and coat structural metals shown on the Plans, including structural steel of all grades, bolts and fasteners, stud shear connectors, welding, special and alloy steels, metallic electrodes, steel forgings and castings, and iron castings. Furnish, fabricate, and install incidental metal construction and elastomeric material not otherwise provided for, according to the Contract.
- B. Related Sections include the following:
 - 1. Division 01 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
 - 2. Division 05 Section "Metal Fabrications" for guardrails and other items not defined as structural steel.

1.3 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC's "Code of Standard Practice for Steel Buildings and Bridges," that support design loads.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication of structural-steel components.
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 2. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
 - 3. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
- C. Welding certificates.
- D. Qualification Data: For fabricator and testing agency.

- E. Mill Test Reports: Signed by manufacturers certifying that the following products comply with requirements:
 - 1. Structural steel including chemical and physical properties.
 - 2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 - 3. Direct-tension indicators.
 - 4. Tension-control, high-strength bolt-nut-washer assemblies.
- F. Source quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator who participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category **Major Steel Bridge (CBR)**.
- B. Welding: Qualify procedures and personnel according to AWS D1.5:2008, "Bridge Welding Code".
- C. Comply with applicable provisions of the following specifications and documents:
 - 1. AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 - 2. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.
 - 1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - 2. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.7 COORDINATION

- A. Furnish anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

- A. General requirements for delivery of rolled steel plates, shapes, and bars for structural use: ASTM A 6
- B. W-Shapes: ASTM A 572, Grade 50 or ASTM A 709, 50 ksi minimum yield strength.
- C. Channels, Angles: ASTM A 572, Grade 50.
- D. Plate and Bar: ASTM A 572/A 572M, Grade.
- E. Welding Electrodes: Comply with AWS requirements.
- F. With written approval, substitute a grade of steel, for that specified, for a particular application where it is desired. Substituted steel must be equal or superior in both physical and chemical properties.

2.2 IMPACT TEST REQUIREMENTS

- A. Meet the supplemental requirements for impact toughness testing (Charpy V-Notch) and marking under ASTM A 709, Zone 3. These supplemental requirements are mandatory for material designated on the Plans as fracture critical (F) or as main members subject to tensile stress (T).
- B. Submit impact test reports to the Engineer.

2.3 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 320, Type L7, heavy hex steel structural bolts; ASTM A 194 Grade 4 or 7 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
 - 1. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C. After galvanizing, ensure that the bolt threads accept galvanized standard nuts without requiring tools or causing removal of protective coatings.
 - 2. Direct-Tension Indicators: ASTM F 959, Type 325 compressible-washer type.
 - a. Finish: **Mechanically deposited zinc coating, ASTM B 695, Class 50.**
- B. Machine Bolts, Nuts, and Washers: ASTM A 307. Provide as indicated in plans.

2.4 RAISED PATTERN PLATE (OR DIAMOND PLATE)

- A. Use steel plates with a raised pattern surface meeting the following requirements:

Use diagonal type pattern, with the intersecting diagonals at right angles to one another. Use the same material for the raised portions of the pattern as the base metal of the plate. The raised pattern must be an inherent part of the plate. The pattern must be continuous throughout the surface of the plate and the projections along any diagonal must be spaced alternately with the projections along the normal diagonals.

2.5 ELASTOMERIC BEARING PADS

A. Meet AASHTO M 251, with the following revisions:

1. Properties of the Elastomer. Replace the first sentence with the following:
 - a. Use elastomeric compound in the construction of the bearings containing only virgin natural polyisoprene (natural rubber) as the raw polymer. Do not use neoprene. Properties and requirements elsewhere in AASHTO M 251 pertaining solely to polychloroprene (neoprene) do not apply.
 - b. Use elastomer compound classified as low temperature Grade 5 and meeting the requirements of the Shear Modulus Test, paragraph 9.4.
2. Amend Table 1 as follows:
 - a. Replace "25" with "50" in the row labeled "Ozone Resistance, Concentration of ozone during test".
 - b. Replace "48" with "100" in the row labeled "Ozone resistance, Duration of test".
3. Add the following paragraph:

5.5. Fabricate pads over 3/4 inch thick with alternating laminations of elastomer and metal or fabric reinforcements. The outside laminations must be metal or fabric with a minimum elastomer cover as shown on the Plans. Use elastomer laminations 1/2 inch thick $\pm 1/8$ inch.

2.6 TEFLON COATED BEARINGS

- A. Furnish bearings with a 3/32 inch thick pad of filled Poly Tetrafluoroethylene (TFE), bonded to the sliding surfaces of the sliding plates, by the manufacturer.
- B. Use a TFE pad meeting the following requirements:

TFE PAD REQUIREMENTS

Tensile Strength, minimum	2000 psi
Tensile Elongation, minimum	200%
Hardness	55-65 Shore D
Coefficient of Friction (TFE against Stainless	0.08 (for loads greater than 1000 psi and

Steel), maximum	speeds less than 1 inch/min.)
Compressive Strength (0.2% offset), minimum	1800 psi
Shear Strength (between TFE and steel plate), minimum	100 psi

2.7 FABRICATION

- A. Shop Inspection: Furnish 30 days notice of when work will begin at the fabrication shop to allow for an inspection.
- B. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges".
 - 1. Camber structural-steel members where indicated.
 - 2. Identify high-strength structural steel according to ASTM A 6/ A 6M and maintain markings until structural steel has been erected.
 - 3. Mark and match-mark materials for field assembly.
 - 4. Complete structural-steel assemblies, including welding of units, before hot dip galvanizing operations.
- C. General:
 - 1. Fabricate steel main members subject to tensile stress and fracture critical members, except for rolled shapes, at a plant certified under the American Institute of Steel Construction (AISC) Quality Certification Program as "Major Steel Bridge," with endorsement "F."
 - 2. Provide workmanship and finish that equal the best general practice in modern bridge shops. Neatly finish portions of the work exposed to view. Carefully and accurately perform shearing, flame cutting, and chipping.
 - 3. Store plain or fabricated structural material at the fabricating shop above the ground on platforms, skids, or other supports. Keep it free from dirt, grease, or other foreign matter. Protect it from corrosion.
 - 4. Ensure that rolled material is straight before being laid off or worked. If straightening is necessary, use methods that will not injure the metal. Do not use material with sharp kinks or bends.
 - 5. Steel or wrought iron may be flame cut provided a mechanical guide is used to secure a smooth surface. Flame cut by hand only where approved, and smooth the surface by planing, chipping, or grinding. Manipulate the cutting flame to avoid cutting beyond the prescribed lines. Fillet re-entrant cuts to a radius of at least 3/4 inch.

6. Ensure that finished members are true to line and free from twists, bends, and open joints.
7. Plane sheared edges of plates more than 5/8 inch thick and carrying calculated stresses to a depth of 1/4 inch deep. Fillet re-entrant cuts before cutting.
8. Make sure the surface finish of bearing and base plates and other bearing surfaces that will contact each other or concrete meets the surface roughness requirements as defined in ANSI/ASME B-46.1, surface roughness, waviness and lay, Part I.
9. Face and bring to an even bearing abutting joints in compression members and girder flanges, and in tension members where specified on the drawings. Where joints are not faced, keep the opening at 1/4 inch or less.
10. Build floor beams, stringers, and girders with end construction angles to the exact length shown on the Plans, as measured between the heels of the connection angles. The permissible tolerance is plus 0 inch to minus 1/16 inch. Where continuity is required, face end connections.
11. Cold bend load-carrying rolled-steel plates as follows:

Take the rolled-steel plates from the stock plates so that the bendline is at right angles to the direction of rolling.

Bend until the radius of the bends, measured to the concave face of the metal, is not less, and preferably more, than shown in the following table, where T is the thickness of the plate.

Angle Through Which Plate is Bent	Minimum Radius
61-90 degrees	1.0 T
91-120 degrees	1.5 T
121-150 degrees	2.0 T

If a shorter radius is essential, bend the plates when hot, but not shorter than a radius of 1.0 T.

Before bending, round the edges of the plate to a radius of 1/16 inch throughout the portion of the plate to be bent.

12. Fit up and attach end and intermediate stiffeners as shown on the Plans. Do not weld ends of stiffeners and other attachments to flanges unless shown on the Plans.
- D. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.
- E. Bolt Holes:

1. Either drill or punch bolt holes. Make finished bolt holes 1/16 inch larger than the nominal diameter of the bolt. Ensure holes are clean cut and without burrs or ragged edges. Material with poorly matched holes will be rejected.
2. When material forming parts of a member is composed of not more than 5 thicknesses of metal, and whenever the thickness of the metal is not greater than 3/4 inch for structural carbon steel or 5/8 inch for alloy steel, either punch or drill the holes to full size.
3. When there are more than 5 thicknesses or when any of the main material is thicker than 3/4 inch in carbon steel, or 5/8 inch in alloy steel, or when required under paragraph 5 below, subpunch or subdrill the holes 3/16 inch smaller. After assembling, ream them to size or drill them from the solid to full size.
4. For punched holes, the diameter of the die must not exceed the diameter of the punch by more than 1/16 inch. Ream any holes that must be enlarged to admit bolts.
5. Ream holes cylindrical and perpendicular to the member. Direct reamers mechanically, where practicable.
6. Ream and drill using twist drills. Assemble connecting parts requiring reamed or drilled holes and securely hold them while reaming or drilling them. Match mark them before disassembling.
7. Subpunch (or subdrill if required) holes for field connections and field splices of main members while assembled in the shop. Obtain approval of the assembly, including camber, alignment, and accuracy of holes and milled joints before beginning reaming.
8. Subpunch and ream holes for floor beam and stringer field end connections to a steel template, or ream them while assembled. When partial assembly is permitted, as provided in paragraph 9 of this Subsection, ream holes for web member connections to steel templates.
9. Ream or drill the full size of the field connection through templates after carefully locating the templates as to position and angle and firmly bolting them. Use exact duplicate templates used to ream matching members or the opposite faces of one member. Accurately locate templates for connections that duplicate so that like members are duplicates and require no matchmarking.
10. Accurately punch holes full-size, subpunch them, or subdrill them so that after assembling (before reaming), a cylindrical pin 1/8 inch smaller in diameter than the nominal size of the punched hole may be entered perpendicular to the face of the member, without drifting, in at least 75% of the contiguous holes in the same plane. If the requirement is not fulfilled, the badly punched pieces will be rejected. If any hole will not pass a pin 3/16 inch smaller in diameter than the nominal size of the punched hole, the material will be rejected.
11. Ream or drill holes so that 85% of the holes in any contiguous group after being reamed or drilled show no offset greater than 1/32 inch between adjacent thicknesses of metal.

12. Provide in steel templates hardened steel bushings in holes accurately dimensioned from the center lines of the connection as inscribed on the template. Use the center lines to locate accurately the template from the milled or scribed ends of the members.

F. Shop Assembling.

1. Assemble in the shop each main member.
2. Clean metal surfaces in contact before assembling them. Assemble, pin well, and firmly draw together the parts of a member with bolts before beginning reaming. Take apart assembled pieces, if necessary, to remove burrs and shavings produced by reaming. Keep the members free of twists, bends, and other deformities.
3. To prepare to shop bolt material punched full-size, spear-ream the bolt holes, if necessary, to admit the bolts. Make the reamed holes no more than 1/16 inch larger than the nominal diameter of the bolts.
4. Secure end connection angles, stiffeners, and similar parts using shipping bolts to prevent damage in shipment and handling.
5. Match mark connecting parts assembled in the shop to allow for reaming holes in field connections. Furnish to the Engineer a diagram showing the marks.

G. Bolted Connections, High-Strength Bolts.

1. Determine bolt lengths by adding the values given in Table 1 to the total thickness of connected material. These values compensate for thickness of nut, bolt point, and washers. Add 5/32 inch to the grip length per each additional flat washer. Adjust the total length to the next longer 1/4 inch increment up to a 5 inch length and to the next longer 1/2 inch increment for lengths over 5 inches.
2. Fit bolted parts solidly together when assembling them and do not separate them by gaskets or other interposed compressible material. Place hardened washers under the turned element.

TABLE 1
BOLT LENGTH DETERMINATION

Bolt Diameter (inches)	Added Length (inches)
1/2	11/16
5/8	7/8
3/4	1
7/8	1-1/8
1	1-1/4
1-1/8	1-1/2
1-1/4	1-5/8

3. Keep assembled joint surfaces, including those adjacent to washers, free of scale except tight mill scale. Clean off dirt, loose rust, burrs, and other defects that would prevent the parts from seating. Keep contact surfaces free of oil, paint, or lacquer.
4. When the outer face of the bolted parts has a slope of more than 1:20, use a smooth beveled washer in contact with the sloped surface.
5. Tighten fasteners to give at least the required minimum tension values shown in Table 2 when the joint is completed. Use bolts and nuts made by the same manufacturer in a connection.

TABLE 2
REQUIRED BOLT TENSION

Bolt Size (inches)	Required Minimum Tension (pounds)
3/4	28,400
7/8	39,250
1	51,500

6. To achieve the minimum tension values shown in Table 2, use direct load indicating washers that conform to ASTM F 959. Demonstrate the suitability of the device by testing a representative sample of at least three devices for each diameter and grade of fastener used in the structure. Test with a calibration device capable of indicating bolt tension. Include in the test assembly flat, hardened washers, if required in the actual connection, arranged as those in the actual connection to be tensioned. Demonstrate with the calibration test that the device indicates a tension at least 5% greater than that required by Table 2. Follow manufacturer's installation procedures when installing bolts in the calibration device and in all connections. Be careful to properly install flat, hardened washers when using load indicating devices with bolts installed in oversized or slotted holes and when using the load indicating devices under the turned element. The load indicating device will count as one washer for the purpose of determining bolt length.
7. Place the load indicating device under the bolt head and turn only the nut when tightening the bolt. The device must indicate full tensioning of the bolt when the opening reaches zero.
8. Install bolts in all holes of the connection and bring them to a snug tight condition. Then, tighten fasteners, progressing systematically from the most rigid part (usually near the center) of the connection to the free edges, or as directed. Keep previously tightened fasteners from relaxing. Multiple systematic tightening cycles may be required.
9. Do not reuse high-strength bolts. Remove previously fully tightened bolts that were loosened by tightening adjacent bolts. Replace them with new bolts, nuts, and load indicating devices.

2.8 SHOP CONNECTIONS

- A. Weld Connections: For bridge girders, perform all welding and Nondestructive Examination (NDE) to comply with AWS D1.5 (comply with AWS D1.1 for railing) for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
- B. Prior to welding, submit for approval a welding plan consisting of the following:
 - 1. Quality Control personnel qualification
 - 2. Welding Procedure Specifications (WPS)
 - 3. Procedure Qualification Records (PQR)
 - 4. Welder Performance Qualification Records (WPQR) with documentation of current welder certification
 - 5. Sample daily inspection sheet
 - 6. Type and extent of NDE to be conducted, as required in the specifications
- C. Perform all Quality Control inspection necessary to ensure the materials and workmanship meet the requirements of the contract documents.
- D. Correct all deficiencies in materials and workmanship revealed by Quality Control and Quality Assurance inspections without additional compensation.
- E. Furnish all completed Quality Control inspection documents to the Engineer.
- F. Follow Charpy V-notch impact test requirements shown herein or on the Plans, except that the impact energy values for filler metals must not be less than that of the base metals to be joined, when tested at the same temperature as the base metal.
- G. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.
 - 1. Verify that weld sizes, fabrication sequence, and equipment used will limit distortions to allowable tolerances.

2.9 BRIDGE COATINGS

- A. Zinc Thermal Spray Finish: Coat bridge girders, diaphragms, angle bracing and other bridge components as practical. Prepare base metal in accordance with SSPC-SP 5 White Metal Blast Cleaning and coat with 6 mil zinc thermal spray in accordance with:
 - 1. SSPC CS - Guide 23.00, June 1, 1991, Coating System Guide, Guide for Thermal Spray Metallic Coating Systems; Steel Structures Painting Council.
 - 2. ANSI/AWS C2.18, Guide for the Protection of Steel With Thermal Spraying Coating of Aluminum and Zinc, American Welding Society
- B. Hot-Dip Galvanized Finish: Galvanize all bridge components that are impractical to coat with thermal spray. Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/ A 123M.

1. Fill vent holes and grind smooth after galvanizing.

2.10 SOURCE QUALITY CONTROL

- A. Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- C. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.5 and the following inspection procedures, at testing agency's option:
 1. Liquid Penetrant Inspection: ASTM E 165.
 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 3. Ultrasonic Inspection: ASTM E 164.
 4. Radiographic Inspection: ASTM E 94.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before starting erection work, inform the Engineer of the proposed erection method and the proposed amount and character of the equipment.
- B. Follow handling and erection procedures so as to avoid inducing critical buckling stresses in the girders.
- C. Submit plans or written procedures for approval depicting the erection method.
- D. The above methods and equipment are subject to the Engineer's approval. However, even with this approval, maintain responsibility for the safety of the method or equipment and complete the work according to the Plans and Specifications. Obtain approval before doing any work.
- E. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

3.2 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- B. Bearing Plates: Clean bearing surfaces of debris to setting bearing plates. Clean bottom surface of bearing plates. Apply epoxy adhesive, meeting AASHTO M 235, to the bottom surface of the elastomeric bearing pads before placing them. Do not move the pad until the epoxy has cured and full adhesion is achieved.
- C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 - 1. Align and adjust girders before permanently fastening.
- D. Splice members only where indicated.
- E. Do not use thermal cutting during erection.
- F. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
- G. Accurately assemble the parts as shown on the Plans and follow match-marks. Handle the material carefully to avoid bending, breaking, or otherwise damaging the parts. Do not hammer if doing so will injure or distort the members. Clean bearing surfaces and surfaces to be in permanent contact before assembling the members. Fit up and tighten bolted joints as specified in Subsection 2.7.G.

3.3 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified. ASTM A 320 bolts shall be installed per the requirements of ASTM A 325 bolts.
 - 1. Joint Type: All steel to steel connections with high strength bolts shall be pretensioned.
- B. Weld Connections: Comply with AWS D1.5 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
 - 1. Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
 - 2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor shall engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.
- B. Bolted Connections: Bolted connections shall be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Field welds will be visually inspected according to AWS D1.5.
- D. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.5 REPAIRS AND PROTECTION

- A. Straightening Bent Material.
 - 1. Straighten plates and angles or other shapes using methods not likely to fracture or injure the material. Heat the metal only when the Engineer permits. Do not heat to a higher temperature than what produces a "dark, cherry-red" color. After heating, cool the metal as slowly as possible. After straightening a bend or buckle, carefully inspect the metal surface for fractures.
- B. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

- 3.6 CLEANUP: Upon completion and before final acceptance of the structure, remove falsework and clean debris from the work site.

END OF SECTION 05 12 00

SECTION 05 52 13 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Steel tube railings.

1.2 SUBMITTALS

- A. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

PART 2 - PRODUCTS

2.1 METALS

- A. Steel:
 - 1. Tubing: ASTM A 500 (cold formed), Grade B.
 - 2. Plates, Shapes, and Bars: ASTM A 36/A 36M.
 - 3. Castings: Either gray or malleable iron, unless otherwise indicated.
 - a. Malleable Iron: ASTM A 47/A 47M.

2.2 MISCELLANEOUS MATERIALS

- A. Fasteners: Provide high strength and machine bolts as noted in the drawings and specified in Specification 055200.
- B. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

2.3 FABRICATION

- A. General: Fabricate railings to comply with design, dimensions, and details indicated.
- B. Welded Connections: Cope components at connections to provide close fit. Weld all around at connections, including at fittings.

2.4 FINISHES

A. Steel:

1. Galvanized Railings: Hot-dip galvanize railings, after fabrication, to comply with ASTM A 123/A 123M. Provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation.
 1. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
 2. Align rails so variations from level for horizontal members do not exceed 1/4 inch in 12 feet.
- B. Attach rails to bridge deck with fabricated brackets as shown.
- C. Adjusting and Cleaning:
 1. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05 52 13

SECTION 06 17 00 - TIMBER CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes timber framing for:
 - 1. Glued-laminated timber deck
 - 2. Timber sills
 - 3. Running Planks

1.2 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.
- B. Shop Drawings: Show layout of structural glued-laminated timber system and full dimensions of each member. Indicate laminating combination.
- C. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the American Lumber Standards Committee Board of Review.
- D. Issued by a qualified testing and inspecting agency indicating that structural glued-laminated timber complies with requirements in AITC A190.1.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Provide factory-glued structural units produced by an AITC- or APA-licensed firm.
 - 1. Factory mark each piece of structural glued-laminated timber with AITC Quality Mark or APA trademark. Place mark on surfaces that will not be exposed in the completed Work.
- B. Quality Standard: Comply with AITC A190.1, "Structural Glued Laminated Timber."

1.4 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with provisions in AITC 111, "Recommended Practice for Protection of Structural Glued Laminated Timber during Transit, Storage, and Erection."

PART 2 - PRODUCTS

2.1 DIMENSION LUMBER

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Omit grade stamp and provide certificates of grade compliance issued by grading agency.
 - 2. Provide dressed lumber, S4S, unless otherwise indicated.
- B. Bridge Sill Material: Provide Douglas Fir Larch No. 2 or better, WCLIB or WWPA.

2.2 STRUCTURAL GLUED-LAMINATED TIMBER

- A. Species and Grades for Structural Glued-Laminated Timber: Provide structural glued-laminated timber made from Douglas fir-larch that complies with structural properties or combination symbols indicated.
- B. Species and Grades for bridge deck and backwall: Provide structural glued-laminated timber that complies with AITC 117--MANUFACTURING or research/evaluation reports acceptable to authorities having jurisdiction and the following:
 - 1. Species and Beam Stress Classification: Douglas fir-larch, 24F-1.8E, Combination E13.
- C. Appearance Grade: Industrial appearance grade, complying with AITC 110.
- D. Adhesive: Wet-use type complying with ASTM D 2559.

2.3 RUNNING PLANKS

- A. Running planks shall be of IPE (Ironwood), Commercial grade, surfaced one-side two-edges (S1S2E).

2.4 CONNECTORS, ANHCORS AND ACCESSORIES

- A. Fabricate from structural-steel shapes, plates, and bars complying with ASTM A 36/A 36M; Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
 - 1. Hot-dip galvanize steel assemblies and fasteners after fabrication to comply with ASTM A 123/A 123M or ASTM A 153/A 153M.

2.5 PRESSURE TREATMENT

A. Structural Glued-Laminated Timber

1. Pressure treat deck and backwall members in conformance with AWP A U1-06 to UC4 for backwall and UC3 for deck material.
2. Reference drawing general notes for other requirements.

B. Timber Sill Material

1. Preservative Treatment by Pressure Process: AWP A C2 with water-borne preservatives.
2. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.

C. Running Planks: Untreated.

2.6 FABRICATION

- A. Shop fabricate for connections to greatest extent possible, including cutting to length and drilling bolt holes.
- B. Camber: No camber.
- C. End-Cut Sealing: Immediately after end-cutting each member to final length, apply a saturation coat of end sealer to ends and other cross-cut surfaces, keeping surfaces flood-coated for not less than 10 minutes.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Erect structural glued-laminated timber as per the plans. Provide temporary bracing to maintain lines and levels until permanent supporting members are in place.
 - 1. Lift with padded slings and protect corners with wood blocking.
- B. Cutting: Avoid extra cutting after fabrication. Where field fitting is unavoidable, comply with requirements for shop fabrication.
- C. Repair damaged surfaces after completing erection. Replace damaged structural glued-laminated timber if repairs are not approved by Engineer.

END OF SECTION 06 17 00

SECTION 26 05 00 – COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. General Requirements specifically applicable to Division 26, in addition to Division 01 provisions.
- B. The electrical system equipment and installation shall comply with all provisions and requirements of this specification, as well as any and all applicable national, state and local codes and standards.

1.2 WORK SEQUENCE

- A. Construct Work in sequence under provisions of Division 01.

1.3 COORDINATION

- A. Coordinate the Work specified in this Division under provisions of Division 01.
- B. Prepare drawings showing proposed rearrangement of Work to meet job conditions, including changes to Work specified under other Sections. Obtain permission of Architect prior to proceeding.

1.4 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code, latest adopted edition including all state and local amendments.
- B. NECA - Standard of Installation.
- C. NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- D. ANSI/IEEE C2 - National Electrical Safety Code latest adopted edition.
- E. Electrical Reference Symbols: The Electrical "Legend" on drawings is standardized version for this project. All symbols shown may not be used on drawings. Use legend as reference for symbols used on plans.
- F. Electrical Drawings: Drawings are diagrammatic; complimentary to the Architectural drawings; not intended to show all features of work. Install material not dimensioned on drawings in a manner to provide a symmetrical appearance. Do not scale drawings for exact equipment locations. Review Architectural, Structural, and Mechanical Drawings and adjust work to conform to conditions shown thereon. Field verification of dimensions, locations and levels is directed.

1.5 REGULATORY REQUIREMENTS

- A. Conform to ANSI/NFPA 70.
- B. Conform to the latest adopted edition of the International Building Code and the International Fire Code including all state and local amendments thereto.
- C. Conform to ANSI/IEEE C2.
- D. Obtain electrical permits, plan review, and inspections from authority having jurisdiction.

1.6 SUBMITTALS

- A. Submit inspection and permit certificates under provisions of Division 01.
- B. Include certificate of final inspection and acceptance from authority having jurisdiction.
- C. Submittal review is for general design and arrangement only and does not relieve the Contractor from any requirements of Contract Documents. Submittal not checked for quantity, dimension, fit or proper operation. Where deviations of substitute product or system performance have not been specifically noted in the submittal by the Contractor, provisions of a complete and satisfactory working installation is the sole responsibility of the Contractor.
- D. In addition to requirements referenced in Division 01, the following is required for work provided under this division of the specification.
 - 1. Provide material and equipment submittals containing complete listings of material and equipment shown on Electrical Drawings and specified herein, bound in hard cover, loose-leaf binders separate from work furnished under other divisions. Index and clearly identify all material and equipment by item, name or designation used on drawings and in specifications.
 - 2. Submit only pages which are pertinent; mark each copy of standard printed data to identify pertinent products, referenced to Specification Section and Article number. Show reference standards, performance characteristics, and capacities; wiring diagrams and controls; component parts; finishes; dimensions; and required clearances.
 - 3. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.
 - 4. Review submittals prior to transmittal; determine and verify field measurements, field construction criteria, manufacturer's catalog numbers, and conformance of submittal with requirements of Contract Documents.
 - 5. Coordinate submittals with requirements of work and of Contract Documents.
 - 6. Sign or initial each sheet of shop drawings and product data, and each sample label to certify compliance with requirements of Contract Documents. Notify Architect/Engineer in writing at time of submittal, of any deviations from requirements of Contract Documents.
 - 7. Do not fabricate products or begin work which requires submittals until return of submittal with Architect/Engineer acceptance.
 - 8. Equipment scheduled by manufacturer's name and catalog designations, manufacturer's published data and/or specification for that item, in effect on bid date, are considered part

of this specification. Approval of other manufacturer's item proposed is contingent upon compliance therewith.

9. Submittals for Division 26 shall be complete and submitted at one time. Unless given prior approval, partial submittals will be returned unreviewed.

1.7 SUBSTITUTIONS

- A. In accordance with the General Conditions and the General Requirements, Substitution and Product Options, all substitute items must fit in the available space, and be of equal or better quality including efficiency performance, size, and weight, and must be compatible with existing equipment.

1.8 PROJECT RECORD DRAWINGS

- A. Maintain project record drawings in accordance with Division 01.
- B. In addition to the other requirements, mark up a clean set of drawings as the work progresses to show the dimensioned location and routing of all electrical work which will become permanently concealed. Show routing of work in permanently concealed blind spaces within the building. Show complete routing and sizing of any significant revisions to the systems shown.
- C. Record drawing field mark-ups shall be maintained on-site and shall be available for examination of the Owner's Representative at all times.

1.9 OPERATION AND MAINTENANCE MANUALS

- A. Provide operation and maintenance manuals for training of Owner's Representative in operation and maintenance of systems and related equipment. In addition to requirements referenced in Division 01, the following is required for work provided under this section of the specifications.
- B. Manuals shall be hard cover, loose-leaf binders with pages reinforced to prevent pullout and shall be separate from work furnished under other divisions. Prepare a separate chapter for instruction of each class of equipment or system. Index and clearly identify each chapter and provide a table of contents.
- C. Unless otherwise noted in Division 01, provide one copy of all material for approval. After approval, provide five corrected approved copies.
- D. The following is the suggested outline for operation and maintenance manuals and is presented to indicate the extent of items required in manuals.
 1. List chapters of information comprising the text. The following is a typical Table of Contents:
 - a. Electrical power distribution
 - b. Lighting
 - c. Other chapters as necessary
 2. Provide the following items in sequence for each chapter shown in Table of Contents:
 - a. Describe the procedures necessary for personnel to operate the system including start-up, operation, emergency operation and shutdown.

- 1) Give complete instructions for energizing equipment and making initial settings and adjustments whenever applicable.
- 2) Give step-by-step instructions for shutdown procedure if a particular sequence is required.
- 3) Include test results of all tests required by this and other sections of the specifications.
- b. Maintenance Instructions:
 - 1) Provide instructions and a schedule of preventive maintenance, in tabular form, for all routine cleaning and inspection with recommended lubricants if required for the following:
 - a) Lighting fixtures
 - b) Distribution equipment
 - 2) Provide instructions for minor repair or adjustments required for preventive maintenance routines, limited to repairs and adjustments which may be performed without special tools or test equipment and which requires no special training or skills.
 - 3) Provide manufacturers' descriptive literature including approved shop drawings covering devices used in system, together with illustrations, exploded views, etc. Also include special devices provided by the Contractor.
 - 4) Provide any information of a maintenance nature covering warranty items, etc., which have not been discussed elsewhere.
 - 5) Include list of all equipment furnished for project, where purchased, technical representative if applicable and a local parts source with a tabulation of descriptive data of all electrical-electronic spare parts and all mechanical spare parts proposed for each type of equipment or system. Properly identify each part by part number and manufacturer.

1.10 DEMONSTRATION OF ELECTRICAL SYSTEMS

A. During substantial completion inspection:

1. Conduct operating test for approval under provisions of Division 01.
2. Demonstrate installation to operate satisfactorily in accordance with requirements of Contract Documents.
3. Should any portion of installation fail to meet requirements of Contract Documents, repair or replace items failing to meet requirements until items can be demonstrated to comply.
4. Have instruments available for measuring light intensities, voltage and current values, and for demonstration of continuity, grounds, or open circuit conditions.
5. Provide personnel to assist in taking measurements and making tests.

1.11 WARRANTY

- A. In addition to the requirements of Division 1, warrant all materials, installation and workmanship for one (1) year from date of acceptance.
- B. Copies of manufacturer product warranties for all equipment shall be included in the operation and installation manuals.

1.12 INSTRUCTION OF OPERATING PERSONNEL

- A. In accordance with the requirements of Division 01 and this section provide services of qualified representative of supplier of each item or system listed below to instruct designated personnel of Owner in operation and maintenance of item or system.
- B. Make instruction when system is complete, of number of hours indicated, and performed at time mutually agreeable.
- C. Certify that an Anchorage, based authorized service organization regularly carries complete stock of repair parts for listed equipment or systems, that organization is available and will furnish service within 48 hours after request. Include name, address and telephone number of service organization.
- D. Have approved operation and maintenance manuals and parts lists for all equipment on hand at time of instruction.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. All Materials and Equipment shall be new and Underwriter's Laboratories listed for the use intended.
- B. Materials and Equipment shall be acceptable to the authority having jurisdiction as suitable for the use intended when installed per listing and labeling instructions.
- C. No materials or equipment containing asbestos in any form shall be used. Where materials or equipment provided by this Contractor are found to contain asbestos such items shall be removed and replaced with non-asbestos containing materials and equipment at no cost to the Owner.
- D. In describing the various items of equipment, in general, each item will be described singularly, even though there may be numerous similar items.

PART 3 - EXECUTION

3.1 WORKMANSHIP

- A. Install Work using procedures defined in NECA Standard of Installation and/or the manufacturer's installation instructions.

3.2 TESTS

- A. Notify Contracting Officer at least 72 hours prior to conducting any tests.
- B. Following completion of installation, test system ground in accordance with the requirements of NETA ATS 7.13. and all feeders in accordance with NETA ATS 7.3. Submit logs of values obtained, and nameplate data of instruments used prior to final inspection. Include a copy of all data in the power distribution section of the Operation and Maintenance Manuals.
- C. Perform additional tests required under other sections of these specifications.
- D. Perform all tests in the presence of the Owner's authorized representative.

END OF SECTION 26 05 00

SECTION 26 05 26 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Power system grounding.
- B. Electrical equipment and raceway grounding and bonding.

1.2 RELATED SECTIONS

- A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements and Section 26 05 00 – Basic Electrical Requirements.
- B. Division 01 – Quality Requirements.
- C. Section 26 05 00 – Basic Electrical Requirements.
- D. Section 27 05 26 – Grounding and Bonding for Electrical Systems.

1.3 REFERENCE STANDARDS

- A. ANSI/NEMA GR-1 – 2001, Ground Rod Electrodes and Ground Rod Electrode Couplings.
- B. ANSI/NFPA 70 – 2005 National Electrical Code.
- C. ASTM B 3 – 2001 Standard Specification for Soft or Annealed Copper Wire.
- D. AWS A5.8/A5.8M – 1992; R2004 Specification for Filler Metals for Brazing and Braze Welding.
- E. IEEE Std 81 – 1983 Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.
- F. IEEE Std 142 – Recommended Practice for Grounding of Industrial and Commercial Power System.
- G. UL 467 – 2004 Standard for Grounding and Bonding Equipment.

1.4 SYSTEM DESCRIPTION

- A. Provide a complete grounding system for services and equipment as required by State Codes, NEC, applicable portions of other NFPA codes, and as indicated herein.

1.5 SUBMITTALS

- A. Product Data: Submit product data for all components provided, showing material type and dimensions. Each catalog sheet should be clearly marked to indicate exact part number provided, including all options and accessories.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Drawings

- 1. Accurately indicate actual locations of main grounding bus, all grounding rods, concrete encased electrodes, etc.
- 2. Show the actual installed routing of grounding electrode conductor, and size/type of bonding conductors and termination locations of all major bonding connections (water, piping, steel, fuel tanks, etc.).

B. Test Reports

- 1. The results of electrical ground resistance test, performed on the installed grounding system shall be submitted in accordance with the paragraph entitled "Field Quality Control" of this section.
- 2. Each test report shall include:
 - a. Date of test, soil moisture content, and soil temperature
 - b. Test operator
 - c. Instrument or other test equipment used
 - d. Electrode designation or location matching that shown on shop drawings
 - e. Ground impedance in ohms
 - f. Assumptions made - if required

1.7 COORDINATIONS

- A. Division 01 – Administrative Requirements: Requirements for Coordination.
- B. Complete grounding and bonding of building reinforcing steel prior to concrete placement.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Solid Ground Rods: Copper-encased steel, $\frac{3}{4}$ inch diameter, minimum length 10 feet. Ground rods shall be clean and smooth.
- B. Bonding Conductors: Solid bare copper wire for sizes No. 8 AWG and smaller diameter. Stranded bare copper wire for sizes No. 6 AWG and larger diameter. Conductors may be insulated conductors if used provide green insulation.
- C. Grounding Conductors: Copper conductor bare or green insulated.

- D. Mechanical Grounding and Bonding Connectors: Non-reversible crimp type lugs only. Use factory made compression lug for all terminations.
- E. Exothermic Grounding and Bonding Connectors: Exothermic welded type. Welding procedure shall include the proper mold and powder charge and shall conform to the manufacturer's recommendations.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide a separate, insulated equipment-grounding conductor in all branch circuits. Terminate each end on a grounding lug, bus, or bushing. Multiple conductors on single lug not permitted. Each grounding conductor shall terminate on its own terminal lug.
- B. Supplementary Grounding Electrode: Use driven ground rod on exterior of building.
- C. Bond together system neutrals, service equipment enclosures, exposed non-current carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and plumbing systems.
- D. Grounding conductors for branch circuits shall be sized in accordance with NEC, except minimum size grounding conductor shall be No. 12 AWG.
- E. Grounding conductor is in addition to neutral conductor and in no case shall neutral conductor serve as grounding means.

3.2 FIELD QUALITY CONTROL

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
- B. Upon completion of the ground installation and before connection to the permanent facility power the Contractor shall measure the ground resistance of the grounding electrode system. The Contractor shall notify the Owner's representatives a minimum of 5 business days prior to the scheduled ground testing date so they may be present at the time of testing. The Contractor shall immediately notify the Owner's representative if the measured ground resistance is above 20 ohms. The Contractor shall submit a copy of the test report to the Owner's representative within 10 days after testing and before the ground system becomes inaccessible.
- C. Continuity Test: Continuity test shall be performed on all power receptacles to ensure that the ground terminals are properly grounded to the facility ground system.

END OF SECTION 26 05 26

SECTION 26 05 29 - HANGARS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDED

- A. Conduit supports.
- B. Formed steel channel.
- C. Sleeves.

1.2 RELATED WORK

- A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements, and Section 26 05 00 – Basic Electrical Requirements.

1.3 REFERENCES

- A. International Building Code (IBC), Chapter 16 – Structural Design.

1.4 QUALITY ASSURANCE

- A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

PART 2 - PRODUCTS

2.1 CONDUIT SUPPORTS

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. Minerallac Fastening Systems.
 - 3. O-Z Gedney Co.
 - 4. Substitutions: per Division 01
- B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.
- C. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.
- D. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.

- E. Conduit clamps - general purpose: One-hole malleable iron for surface mounted conduits.
- F. Cable Ties: High strength nylon temperature rated to 185 degrees F (85 degrees C). Self locking.

2.2 FORMED STEEL CHANNEL

- A. Manufacturers:
 - 1. B-Line Systems
 - 2. Allied Tube & Conduit Corp.
 - 3. Unistrut Corp.
 - 4. Substitutions: per Division 01
- B. Product Description: Galvanized 12 gage (2.8 mm) thick steel. With holes 1-1/2 inches (38 mm) on center.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Division 01: Verification of existing conditions before starting work.
- B. Verify openings are ready to receive sleeves.

3.2 PREPARATION

- A. Obtain permission from Owner's Representative before using powder-actuated anchors.
- B. Obtain permission from Owner's Representative before drilling or cutting structural members.

3.3 INSTALLATION - GENERAL

- A. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.
- B. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- C. Securely fasten fixtures and equipment to building structure in accordance with manufacturer's recommendations and to provide necessary earthquake anchorage.
- D. Provide wall attached fixtures and equipment weighing less than 50 pounds with backing plates of at least 1/8" x 10" sheet steel or 2" x 10" fire retardant treated wood securely built into the structural walls. Submit attachment details of heavier equipment for approval.

3.4 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with adjustable interlocking rubber links.
- B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.
- C. Set sleeves in position in forms. Provide reinforcing around sleeves.
- D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- E. Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with fire stopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- F. Install stainless steel escutcheons at finished surfaces.

END OF SECTION 26 05 29

SECTION 26 05 33 – RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Metal conduit.
- B. Flexible metal conduit.
- C. Liquidtight metal conduit.
- D. Electrical metallic tubing.
- E. Nonmetal conduit.
- F. Fittings and conduit bodies.
- G. Wall and ceiling outlet boxes.
- H. Pull and junction boxes.

1.2 RELATED SECTIONS

- A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions,
- B. Division 01 - General Requirements, Summary, Administrative Requirements
- C. Division 07 Thermal and Moisture Protection.
- D. Section 26 05 00 – Basic Electrical Requirements
- E. Section 26 05 19 – Cables.
- F. Section 26 05 26 – Grounding and Bonding for Electrical Systems.
- G. Section 26 05 29 – Hangers and Supports for Electrical Systems.
- H. Section 26 05 53 – Identification for Electrical Systems.
- I. Section 26 27 16 – Cabinets and Enclosures.
- J. Section 26 27 26 – Wiring Devices.

1.3 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
 - 2. ANSI C80.3 - Electrical Metallic Tubing, Zinc Coated.
- B. American Society for Testing and Materials (ASTM):
 - 1. ASTM A 123 – Specification for Zinc Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars and Strip.
- C. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
 - 2. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 3. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports.
 - 4. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - 5. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.
 - 6. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- D. National Fire Protection Association (NFPA):
 - 1. NFPA 70 - National Electrical Code.
- E. International Building Code (IBC):
 - 1. IBC chapter 16 seismic requirements.

1.4 RACEWAY AND BOX INSTALLATION SCHEDULE

- A. Raceway Minimum Size:
 - 1. Below Grade: Provide 1/2 inch minimum, unless otherwise noted.
 - 2. Above Grade or Slab on Grade: Provide 1/2 inch minimum, unless otherwise noted. Raceway may be reduced to 1/2 inch for final connection of raceway up to 6 feet for connection to fixture or device where maximum conduit entry size is 1/2 inch.
- B. Underground more than 5 feet from foundation wall:
 - 1. Raceway: Provide rigid steel conduit or intermediate metal conduit. Schedule 40 plastic conduit.
 - a. Provide detectable warning tape over all underground raceways per 26 05 53.
 - b. Provide 3-inch minimum spacing between raceways.
 - c. Provide 3/4 inch minus material 6 inches above and below conduit. Backfill remaining trench free of debris or rocks greater than 1 inch in diameter.
 - 2. Boxes and Enclosures: Provide concrete type 1A handhole.

- C. Under or in concrete slab, or underground within 5 feet of foundation wall:
 - 1. Raceway: Provide rigid steel conduit, intermediate metal conduit, or schedule 40 plastic conduit. Provide transition to rigid steel conduit 12 inches prior to exit penetration through foundations, concrete walls, or block walls. Provide transition to rigid steel conduit elbow and riser for penetration through slab. Arrange raceway so the curved portion of bend is not visible above finished slab.
- D. Outdoor Above Grade, Damp or Wet Interior Locations:
 - 1. Raceway: Provide rigid steel conduit or intermediate metal conduit.
 - 2. Boxes and Enclosures: Provide weatherproof malleable iron for branch circuit junction and outlet boxes. Provide weatherproof NEMA 3R sheet metal enclosures for safety and disconnect switches as scheduled on Plans.
 - 3. Fittings: Provide galvanized malleable iron with gaskets. Provide Myers threaded hubs for all conduit entries into top and side of sheet metal enclosures.

1.5 DESIGN REQUIREMENTS

- A. Conduit Minimum Raceway Size: Conduit is sized on the drawings for copper conductors with 600-Volt type XHHW insulation, unless otherwise noted. Size all raceways not shown on the drawings to not exceed the percentage fill specified in the NEC Table 1, Chapter 9 using the conduit dimensions of the NEC Table 4, Chapter 9 and conductor properties of the NEC Table 5, Chapter 9. Where specific cable is not listed, use cable diameter provided by the manufacturer.
- B. Box Minimum Size: Provide all boxes sized and configured per NEC Article 370 and as specified in this section.
- C. Seismic Support: Provide support in accordance with section 26 05 29.

1.6 SUBMITTALS

- A. Section 01 33 00 - Submittals and Section 26 05 00 - Electrical General Provisions.
- B. Product Data: Submit data for products to be provided.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- B. Protect PVC conduit from sunlight.

PART 2 - PRODUCTS

2.1 RIGID METAL CONDUIT (RMC)

- A. Rigid Steel Conduit: ANSI C80.1, UL 6.
- B. Fittings and Conduit Bodies: NEMA FB 1, UL 514B; Galvanized malleable iron with threaded hubs for all conduit entries. Provide threaded connections and couplings only. Set Screw and running thread fittings are not permitted.
- C. Provide insulated throat bushings at all conduit terminations.

2.2 INTERMEDIATE METAL CONDUIT (IMC)

- A. Product Description: ANSI C80.6, UL 1242; Galvanized Steel Conduit.
- B. Fittings and Conduit Bodies: NEMA FB 1, UL 514B; use fittings and conduit bodies specified above for rigid steel conduit.

2.3 FLEXIBLE METAL CONDUIT (FMC)

- A. Product Description: UL 1, FS WW-C-566; galvanized or zinc-coated flexible steel, full-wall thickness. Reduced-wall flexible metal conduit is not acceptable.
- B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel or malleable iron with insulated throat bushings. Die cast zinc or threaded inside throat fittings are not acceptable.

2.4 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Product Description: UL 360, flexible metal conduit with interlocked steel construction and PVC jacket.
- B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; liquid tight steel or malleable iron with insulated throat bushings. Die cast fittings are not acceptable.

2.5 ELECTRICAL METALLIC TUBING (EMT)

- A. Product Description: ANSI C80.3, UL 797; galvanized steel tubing.
- B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel or malleable iron, compression or set screw type with insulated throat bushings. Zinc die cast or indentor fittings are not acceptable.
- C. Maximum size shall be 2". Provide factory elbows on sizes 1-½" and larger.

2.6 RIGID NONMETALLIC CONDUIT (RNC)

- A. Product Description: NEMA TC 2; Schedule 40 PVC, rated for 90° C cable.

- B. Fittings and Conduit Bodies: NEMA TC 3.

2.7 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1, UL514A galvanized steel, with plaster ring where applicable.
 - 1. Minimum Size: 4 inches square or octagonal, 1-1/2 inches deep, unless otherwise noted.
 - 2. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch male fixture studs where required. Minimum Size: 4 inches square or octagonal, 2-1/8 inches deep.
 - 3. Concrete and Masonry: Concrete type with field installed tape cover to prevent concrete entry to raceway system. Minimum Size: 4 inches square, 2-1/8 inches deep.
- B. Cast Boxes: NEMA FB 1, Type FD, galvanized malleable iron. Furnish gasketed cover by box manufacturer. Furnish threaded hubs. "Bell" boxes are not acceptable.
- C. Wall Plates: As specified in Section 26 27 26.

2.8 PULL AND JUNCTION BOXES

- A. Sheet Metal Pull and Junction Boxes: ANSI/NEMA OS 1, UL514A galvanized steel.
 - 1. Minimum Size: 4 inches square or octagonal, 1-1/2 inches deep, unless otherwise noted.
- B. Cast Metal Boxes for Outdoor and Wet Location Installations: NEMA 250, Type 4; flat-flanged, surface mounted junction box, UL listed as raintight:
 - 1. Material: Galvanized cast iron or copper-free cast aluminum.
 - 2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover and screws.
- C. Fiberglass Concrete composite Type 1A Handholes: Die-molded glass-fiber concrete composite hand holes with pre-cut 6 x 6 inch cable entrance at center bottom of each side:
 - 1. Cover: Glass-fiber concrete composite, weatherproof cover with non-skid finish.
 - 2. Cover Legend: "ELECTRIC"
- D. Polymer Concrete Junction Boxes for Underground Installations: Polymer concrete consisting of sand and aggregate bound together with a polymer resin. Internal reinforcement shall be provided by means of steel, fiberglass or a combination of the two. The installed enclosure shall be rated for a minimum test load of 7500 pounds distributed over a 10 inch by 10 inch area and used in occasional, non-deliberate vehicular traffic or pedestrian traffic application. All hardware shall be stainless steel.

2.9 EXPANSION FITTINGS:

- A. Galvanized malleable iron, galvanized with grounding bond jumper.

2.10 BUSHINGS:

- A. Non-grounding: Threaded impact resistant plastic.
- B. Grounding: Insulated galvanized malleable iron/steel with hardened screw bond to raceway and conductor lug.

2.11 LOCKNUTS:

- A. Threaded Electro Zinc Plated Steel designed to cut through protective coatings for ground continuity.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Ground and bond raceway and boxes in accordance with Section 26 05 26.
- B. Fasten raceway and box supports to structure and finishes in accordance with Section 26 05 29.
- C. Identify raceway and boxes with origin and destination in accordance with Section 26 05 53.
- D. Unless otherwise noted, do not inter-mix conductors from separate panelboards or any other system in the same raceway system or junction boxes.

3.2 INSTALLATION - GENERAL RACEWAY

- A. Install conduit for all systems, unless otherwise noted.
- B. Install a grounding conductor inside of all raceways.
- C. Provide raceways concealed in construction unless specifically noted otherwise, or where installed at surface cabinets, and equipment connections and in Mechanical and Electrical Equipment rooms. Do not route conduits on roofs, outside of exterior walls, or along the surface of interior finished walls unless specifically noted on the plans.
- D. Raceway routing and boxes are shown in approximate locations unless dimensioned. Where raceway routing is not denoted, field-coordinate to provide complete wiring system.
- E. Do not route raceways on floor. Arrange raceway and boxes to maintain a minimum of 6 feet 6 inches of headroom and present a neat appearance. Install raceways level and square to a tolerance of 1/8" per 10 feet. Route exposed raceways and raceways above accessible ceilings parallel and perpendicular to walls, ceiling, and adjacent piping.
- F. Maintain minimum 6-inch clearance between raceway and mechanical and piping and ductwork. Maintain 12-inch clearance between raceway and heat sources such as flues, steam pipes, heating pipes, heating appliances, and other surfaces with temperatures exceeding 104 degrees F.

- G. Do not install conduit imbedded in spray applied fire proofing. Seal conduit penetrations of fire-rated walls, ceilings, floors in accordance with the requirements of Section 26 05 00 and Division 07.
- H. Raceways and boxes penetrating vapor barriers or penetrating areas from cold to warm shall be taped and sealed with a non-hardening duct sealing compound to prevent the accumulation of moisture, and shall include a vapor barrier on the outside.
- I. Conduit embedded in concrete or solid masonry shall not be larger than 1/3 the thickness of the wall or slab and shall be spaced not less than three diameters apart. No cutting of reinforcing bars shall be permitted unless specifically approved. Should structural members prevent the installation of conduit or equipment, notify the Contracting Officer before proceeding.
- J. Route conduits in slabs to have 1 inch minimum cover. Conduits in slab shall not compromise the structural integrity of the slab.
- K. Field coordinate the installation of all conduit installed in or through concrete slabs containing radiant heating piping to avoid conflict with the piping prior to the concrete being poured. Core drilling of slabs with radiant heat piping installed is not allowed.
- L. Arrange raceway supports to prevent misalignment during wiring installation. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- M. Do not attach raceway to ceiling support wires or other piping systems and do not fasten raceway with wire or perforated pipe straps. Remove all wire used for temporary raceway support during construction, before conductors are pulled. Raceway shall be installed to permit ready removal of equipment, piping, ductwork, or ceiling tiles.
- N. Group raceway in parallel runs where practical and use conduit rack constructed of steel channel with conduit straps or clamps, as specified in Section 26 05 29. Provide space on each rack for 25 percent additional raceway.
- O. Cut conduit square; de-burr cut ends. Bring conduit to the shoulder of fittings and couplings and fasten securely. Where locknuts are used, install with one inside box and one outside with dished part against box.
- P. Use threaded raintight conduit hubs for fastening conduit to cast boxes, and for fastening conduit to sheet metal boxes in damp or wet locations. Sealing locknuts are not acceptable.
- Q. Install no more than the equivalent of three 90-degree bends between boxes.
- R. Install conduit bodies to make sharp changes in direction, such as around beams. "Goosenecks" in conduits are not acceptable.
- S. Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2 inch size.
- T. Provide protective plastic bushings or insulated throat bushings at each raceway termination not installed to an enclosure. Bushings shall be threaded to the raceway end or connector.
- U. Avoid moisture traps; install junction box with drain fitting at low points in raceway system.

- V. Install fittings and flexible metal conduit to accommodate 3-axis movements where raceway crosses seismic joints
- W. Install fittings designed and listed to accommodate expansion and contraction where raceway crosses control and expansion joints.
- X. Use cable sealing fittings forming a watertight non-slip connection to pass cords and cables into conduit. Size cable sealing fitting for the conductor outside diameter. Use Appleton CG series or equal cable sealing fittings.
- Y. Use suitable caps to protect installed raceway against entrance of dirt and moisture.
- Z. Provide nylon "jet-line" or approved equal pull string in empty raceway, except sleeves and nipples.
- AA. Paint all exposed conduit to match surface to which it is attached or crosses. Clean greasy or dirty conduit prior to painting in accordance with paint manufacturer's instructions. Where raceway penetrates non-rated ceilings, floors or walls, provide patching, paint and trim to retain architectural aesthetics similar to surroundings
- BB. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting.
- CC. When RNC conduit is approved for use, install PVC-coated rigid steel factory elbows for bends in plastic conduit runs regardless of length.
- DD. Wipe plastic conduit clean and dry before joining. Apply full even coat of cement to entire area that will be inserted into fitting. Let joint cure for 20 minutes minimum.

3.3 INSTALLATION – GENERAL BOXES

- A. Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance. All electrical box locations shown on Drawings are approximate unless dimensioned.
- B. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only. Where installation is inaccessible, install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaries. Coordinate locations and sizes of required access doors with Division 8.
- C. Coordinate layout and installation of boxes to provide adequate headroom and working clearance.
- D. Locate and install boxes to maintain headroom and to present a neat appearance.
- E. Provide knockout closures for unused openings.
- F. Install boxes in walls without damaging wall insulation or reducing its effectiveness.
- G. Do not fasten boxes to ceiling support wires or other piping systems.

- H. Support boxes independently of conduit.
- I. Clean interior of boxes to remove dust, debris, and other material and clean exposed surfaces and restore finish
- J. Provide blank covers or plates for all boxes that do not contain devices.

3.4 INSTALLATION – BURIED CONDUITS

- A. Excavation and backfilling shall be in accordance with these specifications and the applicable portions of Division 31:
 - 1. Excavate and backfill as necessary for proper installation or work.
 - 2. Provide bracing and shoring as necessary or required.
 - 3. Compact backfill under footings, floor slabs and paving using materials and methods specified under Division 31, Earthwork.
 - 4. All conduits outside the building perimeter shall be buried a minimum of 24 inches below grade. Bottom of trench shall be smoothed and all rocks and cobbles 3 inches and larger shall be removed. Conduits shall be bedded in a minimum of 2 inches of sand and shall have a cover of 2 inches minimum of sand. Trench shall be backfilled with non-frost susceptible material and compacted.
 - 5. Conduits below slab on grade shall be installed in the top 6 inches of classified material.
 - 6. Damage to existing underground utilities shall be repaired immediately by the Contractor at no cost to the Owner.

3.5 INSTALLATION – SECURITY RACEWAYS AND SLEEVES

- A. Provide continuous pathway system for all security cables. Provide cable pathway support in accordance with section 26 05 29.
- B. Provide pathways for all security cables with Surface Raceway, Conduit, Cable tray, J-hooks, and chases for the entire length of each cable. Utilize existing j-hook pathways where possible. Where new pathways are required, install new j-hooks in accessible locations to match existing type on maximum 48" centers and within 18" of conduit raceway. Utilize conduit in all inaccessible areas.

END OF SECTION 26 05 33

SECTION 26 56 00 – EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Exterior luminaires and accessories.
- B. Lamps.
- C. Ballasts.
- D. Poles.

1.2 RELATED WORK

- A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements, and Section 26 05 00 – Basic Electrical Requirements.
- B. Division 09 – Finishes: Painting.
- C. Division xx – xx: Mockup for column structure, lens, and light fixture.
- D. Section 26 17 16 – Cabinets and Enclosures: Cabinet for LED power supplies.
- E. Division 31 - Earthwork: Excavation and backfill for utilities on site.

1.3 REFERENCES

- A. ASTM D635 - Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position.

1.4 SUBMITTALS

- A. Product Data: Submit the following:
 - 1. Luminaires: Include manufacturer's product data sheets and/or shop drawings including outline drawings showing support points, weights, and accessory information for each luminaire type.
 - 2. Lamps: Submit manufacturer's product data sheets for each lamp used on the project. Indicate which luminaires each lamp is used in.
 - 3. Ballasts: Submit manufacturer's product data sheets for each different type of ballasts used on the project. Indicate which luminaires each ballast is used in.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Drawings: Indicate actual locations and mounting heights of all lighting fixtures and accessories on the project record drawings.
- B. Operation and Maintenance Manuals:
 - 1. Provide recommended luminaire cleaning and re-lamping schedule. If any luminaire lenses require special lubricants for cleaning, include this in the schedule.
 - 2. Provide detailed bill of materials for all items purchased in this section including distributor's contact name, phone number and pertinent information.
 - 3. Provide luminaire manufacturer's installation instructions.
 - 4. Include any specific warranty information provided by the manufacturer for luminaires, lamps and ballasts.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site, store and protect under provisions of Division 01.

1.7 SPARE PARTS

- A. Provide spare parts under provisions of Division 01.
- B. Lamps: Provide one of each size and type of HID lamp installed.
- C. Lenses: One of each size and type.
- D. Ballasts: One of each size and type installed.

PART 2 - PRODUCTS

2.1 EXTERIOR LUMINAIRES AND ACCESSORIES

- A. Luminaires: Provide UL listed luminaires as scheduled on the drawings or as approved equal.
- B. Listing: Luminaires shall be listed for use in the environment in which they are installed. For example, luminaires installed in return air plenums, direct contact with insulation, or in hazardous, wet, damp, or corrosive locations shall be UL listed for such application.
- C. Accessories: Provide all mounting kits, supports, interconnecting wiring, power supplies, trim kits, gaskets, etc. for a complete installation.

2.2 LAMPS – LED

- A. Light Emitting Diode (LED): Lamps shall have a rated minimum average of 50,000 hours, 3000° K, and listed for operation at –20F minimum.

2.3 ACCEPTABLE MANUFACTURERS - POLES

- A. Union Metal.
- B. Valmont.
- C. General Electric.
- D. Gardco.
- E. Hubbell.
- F. Substitutions: Under provisions of Division 01.

2.4 LIGHTING POLES

- A. Metal Poles: Round tapered steel lighting pole with anchor base. Provide custom finish per Architect.
- B. Wind Load: 100 mph velocity with a gust factor of 1.3 per AASHTO standard specifications for structural supports for highway signs, luminaires and traffic signals with luminaires and brackets mounted.
- C. Hand Hole: Drilled hand access hole at manufacturer's standard location. Provide matching gasketed cover plate.
- D. Anchor Bolts: As recommended by pole manufacturer. Provide template, flat washers, lock washers, and hex nuts for each pole.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install lamps in luminaires and lampholders.
- B. Unless otherwise noted on Plans, provide ballast integral to luminaires, pre-wired and installed at the factory, suitable for use with the selected lamp.
- C. Luminaire Pole Bases: Size and constructed as indicated on Drawings. Project anchor bolts 2 inches minimum above base. Install poles on bases plumb; provide double nuts for adjustment

and pole base covers. After adjusting of pole to be vertical, pack grout under pole base to provide full contact with the foundation.

- D. Bollard Foundation Bases: Size and constructed as indicated on Drawings.
- E. Use belt slings or non-chafing ropes to raise and set pre-finished luminaire poles.
- F. Where luminaire pole bases and bollards are fed from buried conduits, install liquidtight flexible metal conduit for transition from inside the polebase to 60 inches beyond pole foundation.
- G. LED Power Supplies: Install power supplies to be readily accessible. Where power supplies are installed outdoors, provide UL listed enclosures rated to -20F.

3.2 RELAMPING

- A. Relamp luminaires which have failed lamps at completion of Work.

3.3 ADJUSTING AND CLEANING

- A. Align luminaires and clean lenses and diffusers at completion of Work. Clean paint splatters, dirt, and debris from installed luminaires.
- B. Touch up luminaire and pole finish at completion of work.

END OF SECTION 26 56 00

SECTION 31 20 00 - EARTHWORK

PART 1 - GENERAL

1.1 BORROW SOURCE

- A. A borrow source for pit run material is located 0.4 miles from the bridge site south of Eleanor Lake. Material is readily available and road access is good.
- B. All soil materials excavated in the course of the work should be satisfactory for re-use in the project.

1.2 DEFINITIONS

- A. Backfill: Soil material used to fill an excavation.
 - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.
- C. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- D. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
 - 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions changes in the Work.
 - 2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.
- E. Fill: Soil materials used to raise existing grades.
- F. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- G. Subgrade: Surface or elevation remaining after completing excavation, or top surface of existing grade upon which fill is placed.
- H. Utilities: On-site underground pipes and conduits.

1.3 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Engineer and then only after arranging to provide temporary utility services according to requirements indicated.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: ASTM D 2487 Soil Classification Groups GW, GP, GM, SW, SP, and SM or a combination of these groups; free of rock or gravel larger than [3 inches] in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487 or a combination of these groups.
- D. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Protect and maintain erosion and sedimentation controls during earthwork operations.

3.2 EXCAVATION

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered.
 - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.3 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.

- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.
 - 1. Clearance: 12 inches each side of pipe or conduit.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
 - 1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material, 4 inches deeper elsewhere, to allow for bedding course.

3.4 SUBGRADE INSPECTION

If bottom of trench is disturbed by excavation equipment, compact to adequate bearing.

3.5 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

3.6 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for pipe, joints, and fittings.
- C. Place in 6" maximum lifts and compact initial backfill of satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit.
 - 1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- D. Place and compact final backfill of satisfactory soil to final subgrade elevation.

3.7 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:
 - 1. Under structures: 95 percent.
 - 2. Under unpaved roads: 90 percent.
 - 3. For utility trenches, compact each layer of initial and final backfill soil material at 90 percent.

3.8 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated. Slope grades to direct water away from buildings and to prevent ponding.

3.9 ROADWAY COURSES

- A. Place satisfactory material on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place satisfactory material as follows:
 - 1. Shape subgrade to uniform elevations and cross-slope grades.
 - 2. Compact subgrade and satisfactory material courses to required grades, lines, cross sections, and thickness to not less than 90 percent of maximum dry unit weight according to ASTM D 1557.
 - 3. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Owner may engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
- C. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable.
- D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.11 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.12 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it as directed near the existing borrow source.

END OF SECTION 31 20 00

SECTION 31 23 01 - TRENCHING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Scope

1. The Contractor shall supply all labor, materials and equipment required for the construction of trenches as shown on the plans and as described in the Specifications.

B. Related Works Specified Elsewhere

1. Section 31 23 02 – Bedding, Backfill & Grading
2. Section 33 06 02 – Piping

PART 2 - MATERIALS

Not applicable.

PART 3 - PART 3 – EXECUTION

3.1 TRENCH EXCAVATION

- A. Contractor shall excavate trenches in accordance with the typical sections as shown on the plans.

B. Tolerance shall be as follows:

1. Bottom shall be no more than two inches (2") above nor four inches (4") below the established elevation at any point.
2. The mainline trench width shall not be narrower (zero inches) and no more than six inches (6") wider than the dimensions given on the plans. The service connection stub-out excavation width shall be plus or minus six inches (6") from the dimensions specified in the specifications

- C. Hand work shall be performed when necessary to free the bottom and sides of the trench of any ice or other foreign matter or to excavate existing structures or utilities.

3.2 BRINE IN THE TRENCH

- A. Contractor may encounter brine layers or pockets during the excavation of the trench. If brine is encountered, the Owner's Representative is to be contacted immediately and no effort shall be

made to cover up the briny area. The following procedure or an Owner approved substitute shall be used to control and repair the affected area.

1. Notify the Owner's Representative immediately when brine is encountered in the trench.
2. Muck out any brine accumulated in the trench bottom and overexcavate no more than two feet (2') to remove any briny soil. Continue to muck out any brine infiltration until the flow stops due to freezing or the removal of all the briny material.
3. Backfill the overexcavated area with dry 5:1 NFS: bentonite to the original required excavated depth.
4. Continue with normal installation of the mainline piping.

3.3 TRENCH MAINTENANCE

- A. Trenches shall be left in clean condition ready for installation of the direct bury piping. Measures shall be taken to keep snow, surface water and other debris out of the trench.
- B. The amount of trench open at any one time shall be subject to the approval of the Owner's Representative and shall be limited to the minimum required by good construction practice, safety requirements, and access to all property for service, emergency and personal vehicles.
- C. Contractor shall maintain reasonable pedestrian and vehicular access to all properties along the construction area.

3.4 EXISTING UTILITIES

- A. The Contractor shall prepare a work plan explaining their work schedule and identifying those areas where potential or real conflicts with existing utilities occur. The plan shall include interface procedures for locates, bypasses, relocations, temporary connections and notifications. It shall also specify points of contact and responsibilities for work efforts and payment of services. This plan shall be submitted to the Utility for their review and approval at the start of the job. A copy of this plan shall be given to the Owner.
 1. The Contractor shall notify utility company one week in advance of any actual construction in close proximity of an existing utility feature. This notification must be in writing and a copy forwarded to the Owner. It shall contain a brief schedule and scope of work and identify any other coordination agreements between the Contractor and the Utility.
 2. All communication from the Contractor to Utility must be in writing and copies sent to the Owner. All costs associated with the damage to, movement of and bypassing of utilities will be the responsibility of the Contractor even though the work may be performed by the Owner of the utility or a separate contractor.
- B. Contractor shall be responsible for obtaining from the local Utility all underground utility locates. "Underground utility locate" is defined as field marking on the surface by paint, dye, stakes, or any other markings clearly visible at the time of construction which designates the horizontal course or location and approximate depth of the utility facility. When pipes or cables are being located, the locate will signify the center line of the pipe or cable. All utility locates furnished pursuant to this section shall be deemed to be accurate if the field marking provided by the utility is within twenty-four inches (24") horizontally of the center line of the facility and within twenty-

four inches (24") of correct depth. If after obtaining a locate the Contractor still damages a utility, the Contractor is still responsible for all repair costs.

- C. If the Contractor, without first obtaining an underground utility locate, damages an underground utility facility, he shall be strictly liable to the Owner thereof without regard to fault or negligence of any employee for all costs incurred by the utility repairing the damage or replacing the underground utility facility, including administrative overhead.
- D. If the request for locate encompasses excavation work which will require more than one visit to locate the utilities, the Contractor shall provide the Utility with a schedule of excavation work for which locate service is to be provided.
- E. Existing utilities are shown on the plans for information only. They are plotted from information obtained from survey basemapping. There is no guarantee that this information is correct, or that some utility lines may not be shown.

3.5 EXPORT OF SPOIL

- A. Soil removed from trenches and ditches shall be loaded into trucks as soon as excavated and shall be hauled to an approved disposal area, selected by the Contractor.
- B. At the disposal site, spoil shall be placed in a manner to prevent ponding of water; spoil shall be built up with smooth surfaces about one rise to 20 run, with the slope being in the direction of the general slope of the land in the area.

3.6 UTILITY WARNING DITCH TAPE

- A. Contractor will supply utility warning tapes to facilitate future location. Tape will be six inch (6") tracer tape with metallic conductor in thousand foot (1,000') rolls.
- B. Tape shall be placed in ditch as shown on the plans.
- C. Tapes shall be handled with care during extreme cold to prevent cracking.

END OF SECTION 31 23 01

SECTION 31 23 02 BEDDING, BACKFILL AND GRADING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. SCOPE: The Contractor shall supply all labor, materials, and equipment for the installation of the bedding, backfill and grading, as shown on the plans and as described in the Specifications.
- B. Related Works Specified Elsewhere
 - 1. Section 31 23 01 – Trenching
 - 2. Section 33 06 02 – Piping

- 1.2 SUBMITTALS: The Contractor shall submit to the Owner's Representative two copies of a written "Plan of Work" 48 hours prior to the start of the work. This "Plan of Work" shall outline the procedures and sequencing of construction and any changes to the Plans and/or Specifications that the Contractor considers necessary to the successful completion of the work.

PART 2 - MATERIALS

2.1 LEVELING COURSE

Leveling course shall be free from snow and ice and shall be graded within the limits of the following table:

<u>U.S. STD. SIEVE</u>	<u>CUMULATIVE % PASSING (by weight)</u>
1-Inch	100
3/4"	70-100
3/8"	50-80
No. 4	35-65
No. 8	20-50
No. 50	10-30
No. 200	3-8

2.2 BACKFILL

Backfill shall be free of snow, ice and organic material. Backfill material shall conform to the specification for "Aggregate" in the Site Development Materials Package Project manual referenced above. The material shall be an approved sand or gravel with a maximum of 10% passing the #200 sieve.

2.3 BEDDING

Bedding shall be NFS sand and gravel sand and gravel material from a local gravel pit which has been approved by the Owner's Representative for processing NFS. The material shall be graded within the limits of the following table:

<u>U.S. STD. SIEVE</u>	<u>CUMULATIVE % PASSING</u>
3/4"	100
10	30-64
40	9-34
200	0-6

In place moisture content shall be no greater than 10%. Bedding shall be free of ice, snow and organic material.

PART 3 - EXECUTION

3.1 SITE PREPARATION

A. Ditch Work

1. Prior to placing bedding material in the excavated trench or ditch, Contractor shall remove snow, ice, water, and any other materials which may be injurious to the installation of the improvements or can cause loss of compaction when thawed. These injuries materials include, but are not limited to:
 - a. Organic material, frozen lumps or silt or gravel, etc.
 - b. Isolated ice chunks larger than 3" maximum diameter.
 - c. Snow in the trench bottom greater than 1" in thickness.
2. Contractor shall obtain inspection and written approval from the Owner's Representative prior to commencing trench or ditch backfill. Backfilling shall commence immediately after obtaining this approval. Portions of the work left open for more than one day after initial backfilling, such as serve tie-ins or access vault tie-ins, shall be re-inspected and approved prior to backfilling.

B. Open Grading

1. Prior to placement of fill in any open graded area, the Contractor shall inspect the area to determine the presence of any obstructions that may hinder the grading operation and shall report same to the Owner's Representative.

3.2 PLACEMENT AND COMPACTION

- A. Backfill: Trench backfill is defined as the placement of material above the level of bedding material. Material for backfill shall be obtained from trench excavation if the material is suitable or conforms to the specifications for backfill. If the Engineer determines that excavated material is unsuitable for trench backfill, the Contractor shall furnish trench backfill per this specification. Backfill shall be placed in lifts not to exceed 8" (uncompacted) and compacted to the following limits:
 1. Under vehicle surfaces compact to at least 95% of maximum dry unit weight, as determined by ASTM D-1557 or equivalent test procedure.
 2. In utility trenches not beneath vehicle surfaces, compact to at least 90% of maximum dry unit weight, as determined by ASTM D-1557 or equivalent test procedure.
 - a. The Engineer shall be given reasonable time to make field density determinations prior to placement of successive layers of material.
 - b. The maximum dimensions of any particle of the embankment material shall not be greater than two-thirds (2/3) of the compacted thickness of the layer in which it is placed unless specified elsewhere. Oversized material shall be removed. Portions of any layer in which the embankment material becomes segregated shall be removed and replaced with satisfactory material, or shall be added to and remixed to secure proper gradation as directed by the Engineer. Backfill shall not contain broken bituminous pavement or Portland Cement Concrete.
 - c. The Engineer may permit lifts in excess of 8" thickness when backfill is placed over swampy or saturated ground, or where he is satisfied that the Contractor's method and equipment will consistently produce the specified density.
 - d. Construction haul routes across the site should be monitored and periodically varied, and compaction equipment should be operated in a non-vibrating mode, unless otherwise demonstrated during on-site testing to not otherwise disturb (e.g. soften, pump, or liquefy) the underlying fill, subgrade or foundations soils.
3. Bedding
 - a. All pipe shall be placed in bedding, as specified and as shown on the drawings.
 - b. Bedding shall be placed under and around the pipe in lifts not to exceed 8" (uncompacted) and compacted to 95% of maximum dry unit weight, as determined by ASTM D-1557 or equivalent test procedure. In no case shall bedding material be placed above the spring line of the pipe in a single lift.

3.3 UTILITY WARNING TAPE

Contractor will install warning tapes in the locations shown on the Plans. Tape shall be handled with care to minimize cracking of the plastic in extreme cold air.

3.4 PREVENTION OF PIPE MOVEMENT

Contractor shall take precautions to prevent pipe movement during the backfilling effort.

- A. A small amount of vertical displacement of the water lines will be allowed. If the vertical displacement exceeds one tenth of a foot (0.10') at any one location, the pipe will be removed and reset to grade.
- B. Small amounts of lateral movement will be allowed, however the pipe must be sufficiently clear of the wall of the trench to allow the backfill to be placed under the haunches of the pipe.

3.5 FINAL SITE GRADING

- A. After construction of utilities, the Contractor shall return disturbed areas to their original lines and grades using equal or better materials.

3.6 TESTING

- A. Contractor shall cooperate with the Owner-supplied soil testing service during the testing of the bedding and backfill.
- B. Test Failure: In the event that the soils testing procedures result in the identification of bedding and backfill material that does not meet the requirements set forth in the construction specifications, the following action shall be taken by the Construction Contractor:
 - 1. Recompact the material and then have it retested.
 - 2. Excavate the out-of-spec material and replace it with material that meets the specification.

END OF SECTION 31 23 02

SECTION 33 06 02 PIPING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Scope

1. The Contractor shall supply all labor, materials, equipment and process required to furnish piping, as shown on the plans and as described in the Specifications.

B. Related Works Specified Elsewhere

1. Section 31 23 02 – Bedding, Backfill and Grading

1.2 SUBMITTALS

Contractor shall submit complete reproducible shop drawings and manufacturer's printed information for all items supplied under this Specification to be approved, in writing, by the Owner's Representative before construction is undertaken.

1.3 STATIC ELECTRICITY

Contractor shall be cognizant of the static electricity safety precautions and shall inform all workers handling polyethylene pipe of these features. Static electricity charges are generated on polyethylene pipe by friction, particularly during the handling of pipe in storage, shipping, and installation. The flow of air or gas containing dust or scale will also build up significant static charges.

PART 2 - MATERIALS

2.1 PIPING – GENERAL

- A. Materials in direct contact with water must be certified to conform with ANSI/NSF Standard 61 by an ANSI accredited organization.

2.2 DIRECT BURY PIPING

- A. Materials for Water

SECTION 33 06 02 PIPING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Scope

1. The Contractor shall supply all labor, materials, equipment and process required to furnish piping, as shown on the plans and as described in the Specifications.

B. Related Works Specified Elsewhere

1. Section 31 23 02 – Bedding, Backfill and Grading

1.2 SUBMITTALS

Contractor shall submit complete reproducible shop drawings and manufacturer's printed information for all items supplied under this Specification to be approved, in writing, by the Owner's Representative before construction is undertaken.

1.3 STATIC ELECTRICITY

Contractor shall be cognizant of the static electricity safety precautions and shall inform all workers handling polyethylene pipe of these features. Static electricity charges are generated on polyethylene pipe by friction, particularly during the handling of pipe in storage, shipping, and installation. The flow of air or gas containing dust or scale will also build up significant static charges.

PART 2 - MATERIALS

2.1 PIPING – GENERAL

- A. Materials in direct contact with water must be certified to conform with ANSI/NSF Standard 61 by an ANSI accredited organization.

2.2 DIRECT BURY PIPING

- A. Materials for Water

3.2 CARE OF PIPE

A. Handling

1. Use no nooks into ends of pipe.
2. Lift with wide fabric slings or manually.
3. Do not drop pipe.
4. Do not lift bundles without protection bottom layer from crushing, or corner pipes from being cut.
5. Do not handle pipe in any way which causes damage to the pipe, insulation, or jacket.

B. Damage and Repair

1. No damaged pipe shall be installed.
2. Repairs shall be made by removing portions and salvaging usable portions of pipe segment. Damage shall include, but not be limited to, bent or broken ends of pipe, excessively out-of-round pipe, punctured or crushed jacket, and deep scratches in the pipe.
3. Punctures or gouges in the jacket more than 6 inches from the ends may be patched with heat shrink material specified herein.

3.3 HIGH DENSITY POLYETHYLENE PIPE (HDPE) INSTALLATION

- A. Except as otherwise noted all pipe connections shall be butt-fusion connections.
- B. Installation shall be as shown on the Plans.
- C. Butt or side fusions shall be performed in strict compliance with the pipe and/or fitting manufacturer's printed directions. Operation of fusion machines shall be performed in strict compliance with machine manufacturer's printed directions.
- D. Contractor may utilize "INNOGAZ" Electro-fusion Couplings for joining HDPE Pipe, with the approval of the Owner's Representative. Except where specifically designated on the drawings, all pipe and fitting joints shall be butt fusion.
- E. Assembly of pipes may be accomplished by any method Contractor elects within the constraints described below:
 1. Butt fused pipe shall be protected from abrasion and excessive bending. Bending radius shall not be less than 80 times the outside pipe diameter, including insulation.
 2. Contractor may modify butt fusion machine to permit its safe use. Machine shall be restored to original condition after use.
- F. Insulation half-shells, and heat-shrink wrap shall be installed at pipe connections, as shown on the Plans. Maximum gap in half-shells shall be ¼".
- G. HDPE Electrofusion Coupling Installation

1. HDPE Electrofusion Couplings may be utilized to make water/sewer tie-ins at the locations shown on the Plans. With the written approval of the Owner's Representative, Contractor may utilize HDPE Electrofusion Couplings for "Make-up spool" installations.
 2. HDPE Electrofusion Couplings shall be installed in accordance with the manufacturer's printed information. Pipe ends shall be cleaned of all insulation and debris, using a scraper and the manufacturer's end cleaning tool. Pipe ends and interior of coupling shall be wiped with a solvent rag to remove oils immediately before coupling installation. Coupling shall slide free with one hand over pipe.
 3. Pipe and couplings shall be securely held in line-up clamps during installation. Clamps shall remain in place until coupling is cool to touch. Owner's Representative will inspect and approve each HDPE Electrofusion Coupling installation.
 4. After the installation of the HDPE Electrofusion Coupling has been inspected and approved by the Owner's Representative, if required, the connection ends may be ground smooth with an angle grinder and joint will be insulated with urethane halfshells and covered with heat shrink wrap, as shown on the Plans.
- H. Insulation halves (half-shells) for joints shall be trimmed to length as necessary. Cuts shall be square and within one-eighth of an inch (1/8") of total length of cutbacks for joints. Half-shells shall be fixed neatly in joints and may be secured in position with stainless steel bandings or any other corrosion resistant and cold temperature approved material.
- I. Heat shrink sleeves shall be installed in strict compliance with manufacturer's printed directions. Surfaces to receive sleeves shall be free of ice, dirt, grease and other deleterious substances which will degrade the bond between sleeve and jacket. Apply heat uniformly with propane torch in strict compliance with sleeve manufacturer's printed directions. Ensure proper heating of difficult to reach places by using a deflector to direct heat to them. Care shall be exercised to prevent damage to urethane insulation. Contractor shall inform Owner's Representative at least four hours prior to placing heat shrink sleeves so that an inspector will be present when the work is done.
- J. Lower assembled arctic pipe into ditch carefully. Do not allow to deflect beyond elastic capacity of heat shrink sleeves as stated in manufacturer's literature. If it is determined that sleeves are being damaged (such as made evident by wrinkling, tearing, strength, breaking loose from outer jacket or the like), Contractor shall reduce deflections. Sleeves and arctic pipe found to be damaged shall be repaired or replaced to the satisfaction of and at no cost to the Owner.
- K. Backfill ditch as noted in Specification Section 31 23 02 Bedding, Backfill and Grading and as shown on the Plans.
- L. Contractor shall be responsible for holding arctic pipes to grade during backfill, per Specification Section 31 23 02 Bedding, Backfill and Grading.

3.4 FLUSHING, TESTING AND DISINFECTION

- A. Contractor shall notify the Owner's Authorized Representative, in writing, twenty-four hours in advance of all testing.
- B. Prior to any tests performed, all water and sewer lines shall be open bore flushed. The Contractor, at his option, shall perform the disinfection and hydrostatic testing in any order of sequence. In the event the disinfection has been performed and repairs are made on the system in

order to pass the hydrostatic test, then the open-bore flush and disinfection will be null and void and shall be repeated to the satisfaction of the Engineer.

C. Mainline Pipe Hydrostatic Testing for Water and Sewer Piping

1. Testing shall be conducted in the presence of the Owner's Representative after final assembly of all piping. All hydrotesting shall be done with potable water.
2. The entire water piping system shall be tested as one line.
3. Contractor shall provide all equipment, labor and materials for hydrostatic testing. This includes, but is not limited to, piping, pumps, test gauges and potable water. The pressure gauge shall be a recording type which will give a permanent record of the test.
4. Contractor shall hydrostatic test all water lines at a pressure of 150 psig, for three hours, with no decrease in line pressure. Contractor shall hydrostatic test all water lines at a pressure of 70 psig, for three hours, with no decrease in line pressure.
5. Contractor shall visually inspect all mechanical piping connections in the presence of the Owner's Authorized Representative, for leaks.
6. Contractor shall repair any portion of the piping system which leaks, or which fails to pass the hydrotest, at no expense to the Owner.
7. Contractor shall deliver to the Owner a statement, signed by the Contractor's Authorized Representative, that the hydrostatic test was satisfactorily completed.

D. Disinfection of Water Mains

1. Contractor shall provide the disinfection for the water lines after all testing is completed. This disinfection shall be done in accordance with all applicable local, state, and federal guidelines. Disinfection shall be supervised by an individual holding current certification by the State of Alaska Department of Environmental Conservation to perform this work on systems of this size. Contractor shall submit a Certificate of Completion attesting to the fact that this disinfection has been performed, signed by this individual.
2. Chlorine, in the form of calcium hypochlorite and water mixture, shall be used for disinfection. The chlorinating agent shall be applied at the beginning of the section adjacent to the feeder connection, insuring treatment of the entire line. Water shall be fed slowly into the new line with chlorine applied in amounts to produce a dosage of forty (40) ppm to fifty (50) ppm. Application of the chlorine solution shall continue until the required dosage is evident at all extremities of the newly laid line. Calcium hypochlorite shall be injected or pumped into the water main. Hydrostatic testing of a water line containing the chlorine mixture will not be allowed.
3. A residual of not less than five (5) ppm chlorine shall be produced in all parts of the water main and retained for a minimum period of twenty-four (24) hours. After which this residual shall be flushed from the line at its extremities until the replacement water tests are equal chemically and bacteriologically to those of the permanent source of supply. In no instance shall a water main be chlorinated before "Open-Bore" flushing.

END OF SECTION 33 06 02